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Application of organic preservatives for sustainable storage of dried fishes

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Abstract

The study was conducted in Saidpur city dried fish market of Nilphamari District under Rangpur Division of Bangladesh from January 2018 to April 2019 to evaluate sustainable storage of dry fishes using organic preservatives. A survey questionnaire was developed for using data collection from dry fish producers, stakeholder, retailers in dry fish markets. Local people of Saidpur city are not strongly habituated to take dry fishes but these fishes fulfill the demand of protein of the inhabitant of North-Bengal region of Bangladesh. There were about 60 dry fish shops with 14 owners in Saidpur dry fish market and consumed mainly by the lower-class local people (65%). Higher-class people were not so much interested to consume due to using chemicals or pesticides in dried fishes for storage. Most of the supplied fishes are marine (75%) and fresh water fishes (25%). During study period, ten (10) species of dry fishes were available in this market. Gradually people choice were-Pama (*Otolithoides pama*), Spider Prawn (*Macrobrachium tenuipes*), Bombay Duck (*Harpadon nehereus*), Silver Razorbelly Minnow (*Salmostoma acinaces*), Spotfin Swamp Barb (*Puntius sophore*), Indian Carplet (*Amblypharungodon mola*), Striped Dwarf Catfish (*Mystus vittatus*), Striped Spiny Eel (*Macragnathus pancalus*), Ribbon Fish (*Trichiurus mutica*) and Gangetic Hairfin Anchovy (*Setipinna phasa*). Rats are major rodent pest of these markets, and in rainy season fungi and insect were damaged dry fishes. The crucial complications were spoilage, absence of inadequate storage services, and using harmful chemicals in dried fishes. For the preservation of these dried fishes *Azadirachta indica* (Neem leaf powder) and Paprika (Pepper powder) were used around the bag once a year at the dose of 2.00 gm Kg⁻¹ and 4.00 gm Kg⁻¹ respectively. Though the price of dry fish is double than raw fish and profit is fourfold. However, if dry fishes were prepared in a good condition using organic preservatives then it can be stored for a long time as the ultimate good source of protein.

Keywords: Organic preservatives, sustainable storage, dry fish, saidpur city

Introduction

Saidpur is an upazila under Nilphamari district of Bangladesh has been established a renowned dry-fish market in 1983. This market is the second largest market of Bangladesh after Chattogram. The business month of these dry fishes are from February to September. Most of the fishes are caught from Bay of Bengal except Banded Snakehead (*Channa striata*) from 'Chalan Beel' of Pabna, Natore, and Bogura district. Middle or lower-income people have chosen Pama Fish (Poa). However, dry fishes fulfilled the demand of protein of the inhabitant of North-Bengal region of Bangladesh. Dry fish contains 65-70% Protein, 15-20% Fat, Omega-3, Omega-6, etc. ^[1]. Marine dry fish also the sources of different minerals and vitamins. Nevertheless, the dry fish producers use numerous chemicals or pesticides like as DDT, Sobicron, Selcron, Setara, Nogos, Rocket and Sumithion to kill the bacteria for producing dry fish in the traditional system which is destructive for human health.

In Bangladesh, natural calamity (Cyclone Sidr) in Sundarbans in November 15, 2007; there were devastated huge losses in this market. In Natore district, there were only two months business of dry fish were remarkable. Indian Shrimp in Bangladesh is called Jhingla fish and in northern region this is Jal fish and these kinds of dry fish is not tasty to Bangladeshi people. The businessmen face huge losses in rainy season for the excess moisture in the air which enhances fungus and insects attack. That time the raw fishes or dust is sold as poultry feed, field manure, and sometimes in beef fattening. Dry fish markets are huge in Bangladesh. This item is very cheap than raw fishes. Due to strict law of formalin/pesticides now dry fishes are more or less safe. Normally, fishes are good food item for all sorts of people either they are sick or healthy.

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As dry fishes are dry in nature so in cold storage it needs fewer temperatures than raw fishes. The maximum dry fishes of Saidpur city dry fish markets are sea fishes and very few are in fresh water fishes. Due to urbanization, most ponds are covered by soil. Fisheries sector now is trying to overcome these losses by induced breeding of fishes. Fishes are considered white meat which is good for human health. Moreover, the fat contents of small dry fishes are very low. However, dried fishes are one of the vital protein sources in Bangladesh. Most of the people from coastal, central and north-eastern districts of Bangladesh are enjoyed it [2]. Fish drying process is measured as the tiniest expensive technique of fish preservation [3]. In Bangladesh, traditional fish drying system is frequently elementary and hygiene practiced so poor [4]. Therefore, the purpose of the study was how to produce chemicals or pesticide free healthy dry fish using organic preservatives and how to make sure of sustainable storage of dry fishes for the long time to increase

producer's income for promote marketing and their better livelihood. Insecticides free dry fish production, encouraging new market, rising income generation and employment opportunity will be accelerated when organic preservatives will be implemented.

Materials and Methods

The present research was carried out in Saidpur city dried fish market of Nilphamari District under Rangpur Division of Bangladesh from January 2018 to April 2019. The study site is located between 25°46' N and 88°53' E (Fig. 1). Data was collected through survey questionnaire and interview. During the study, direct observation was carried out specially to observe the store room with other appliances where dry fishes were kept for a long time. Survey on the stakeholders, buyers, selling status, mode of business, used organic preservatives, and the local people acceptance about the bad odor of the dry fishes around these markets enriched this section.

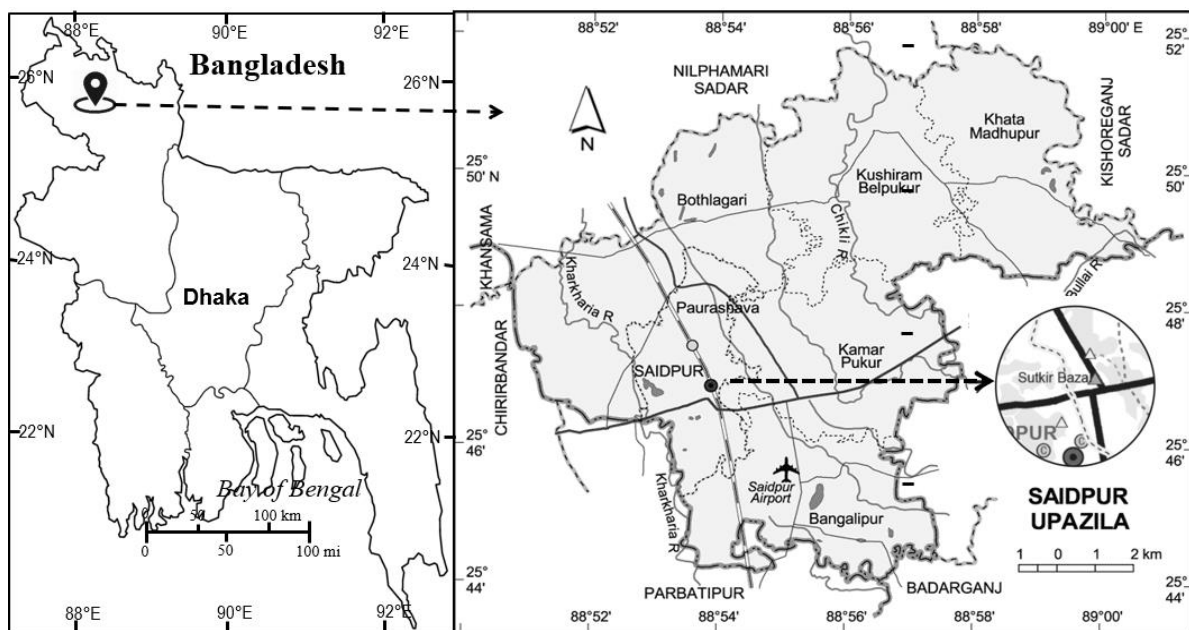


Fig 1: Map showing the location of study area of the Dry fish market at Saidpur city, Bangladesh

Results

There were about 60 dry fish shops with 14 owners in Saidpur dry fish market and consumed mainly by the lower-class local people (65%). Higher-class people were not so much interested to consume due to using chemicals or pesticides in dried fishes for storage. Other consumers of dried fishes were higher-class and middle-class. The value of percentage of consumers are mentioned in the Figure 2.

Most of the supplied dried fishes are marine (75%) and fresh water fishes (25%). During study period, ten (10) species of dried fishes were available in these markets. Gradually people choice were- Pama (*Otolithoides pama*), Spider Prawn (*Macrobrachium tenuipes*), Bombay Duck (*Harpadon nehereus*), Silver Razorbelly Minnow (*Salmostoma acinaces*), Spotfin Swamp Barb (*Puntius sophore*), Indian Carplet (*Amblypharungodon mola*), Striped Dwarf Catfish (*Mystus vittatus*), Striped Spiny Eel (*Macroganathus pancalus*), Ribbon Fish (*Trichiurus mutica*) and Gangetic Hairfin Anchovy (*Setipinna phasa*).

After drying 1 kg fish get 250 grams output which price is average BDT 100-500 per Kilogram. Due to more benefit people (75%) buy dry fish for selling in village area and some (25%) consumes as food. The maximum selling (600 kg per day) were found in April to June and the minimum (20 kg per day) were in December and January. The price of dried fishes was observed to be diverse depend on the size and quality of the finishing product. During study period, the daily highest selling price was about BDT 200 thousand and the lowest was BDT 10 thousand recorded. Poa fish were very common in these markets with price BDT 200-300 /kg. Other common dry fishes were Puti, Mola, Tengra, Bain, Churi, and Phassa

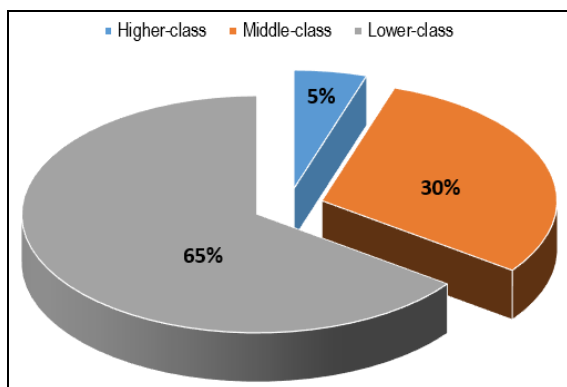


Fig 2: Percentage distribution of dried fish consumers

(Table 1). Large size dry fishes were not accepted by the buyers normally. Here Large Bain (Eel fish) and Snakeheaded

fish are common which is hanged in front of most shops.

Table 1: Available dried fishes in Saidpur city under Nilphamari district of Bangladesh

| Bangla name | English name | Scientific name | Habitat | Price (BDT Kg ⁻¹) |
|--------------|--------------------------|-------------------------------|------------------------|-------------------------------|
| Poa | Pama | <i>Otolithoides pama</i> | Fresh water and Marine | 200-300 |
| Gura Chingri | Spider Prawn | <i>Macrobrachium tenuipes</i> | Fresh water and Marine | 300-500 |
| Laitta | Bombay Duck | <i>Harpadon nehereus</i> | Marine | 400-500 |
| Chela | Silver Razorbelly Minnow | <i>Salmostoma acinaces</i> | Fresh water | 300-400 |
| Puti | Spotfin Swamp Barb | <i>Puntius sophore</i> | Fresh water | 60-120 |
| Mola | Indian Carplet | <i>Amblypharyngodon mola</i> | Fresh water | 150-250 |
| Tengra | Striped Dwarf Catfish | <i>Mystus vittatus</i> | Fresh water | 300-400 |
| Bain | Striped Spiny Eel | <i>Macrogathus pancalus</i> | Fresh water | 300-400 |
| Churi | Ribbon Fish | <i>Trichiurus mutica</i> | Marine | 100-300 |
| Phasa | Gangetic Hairfin Anchovy | <i>Setipinna phasa</i> | Fresh water and Marine | 400-500 |

Rats are major rodent pest of these markets, and in rainy season fungi and insect infestation were serious damaged of dry fishes. The main problem was spoilage, absence of inadequate storing amenities, and using harmful chemicals or pesticides in dried fishes. Some of the dried fish traders who are the concern about food hygiene, they were normally used organic preservatives like as Paprika, Neem leaf powder, Turmeric powder, Salt, etc. Paprika and Neem leaf powder

were very effective organic preservatives for controlling fungus, insect and rat infestation. For the preservation of these dried fishes *Azadirachta indica* (Neem leaf powder) and Paprika (Pepper powder) were used around the bag once a year at the dose of 2.00 gm Kg⁻¹ and 4.00 gm Kg⁻¹ respectively. Though the price of dry fish is double than raw fish and profit is fourfold. The estimated dose of organic preservatives was mentioned in the Table 2.

Table 2: Dose of organic preservative which are estimated by the local dry fish traders

| Organic preservatives | Dose | Control |
|-------------------------|--------------------------|------------------------------------|
| Paprika (Pepper powder) | 4.00 gm Kg ⁻¹ | Fungus, Insect and Rat infestation |
| Neem leaf powder | 2.00 gm Kg ⁻¹ | Fungus, Insect and Rat infestation |
| Turmeric powder | 4.00 gm Kg ⁻¹ | Fungus, Insect and Rat infestation |
| Salt (NaCl) | 125 gm Kg ⁻¹ | Bacteria and moisture control |

Discussion

The demand of dried fishes by the lower-class consumers (65%) were found in Thakurgaon district and 55% of the middle-class consumers were found in Rajshahi district [5]. We have also found 65% consumers are the lower-class local people in Nilphamari district of Bangladesh. Higher-class people were not so much interested to consume due to uses of chemicals or pesticides in dried fishes for storage. To recover the present situation, required to realize the existing marketing both of fresh and dried fishes [5]. In Rajshahi, dry fishes are come from Khulna, Sylhet, and Chattogram and Thakurgaon from Saidpur. There are many traveling vendors and small-scale farmers are available who buy dry fishes from the market and sell in villages. In the high-level of humidity at rainy season, sufficient drying cannot be achieved then stored dried fish will reabsorb moisture and possibility to attack by bacteria, fungal, and insect [4]. Drying technique is measured using the cheapest method of fish preservation [3]. Dry fishes are relished by the people of coastal, central, and north-east districts of Bangladesh due to geographical aspects [2].

Tea polyphenols are gaining importance among researchers as an effective natural food preservative. Dipping in 0.2% tea polyphenol for 90 minutes has been prolonged the shelf life of silver carp by 1 week during iced storage [6]. Extracts from turmeric (*Curcuma longa*), a rich source of antibacterial agent alone or in mixture with shallot (*Allium cepa*) extract (1.5% each, v/v) were found to retain quality characteristics of vacuum-packaged rainbow trout (*Oncorhynchus mykiss*) during a frozen storage of over a period of 20 days [7]. Potato (*Solanum tuberosum*) peel in refrigerated horse mackerel mince and the extract has revealed protective effect on lipid and protein oxidation [8]. Citrus (*Citrus aurantium*) peel

extract has good antioxidant and antimicrobial activities and the shelf life of Indian mackerel by 2 days compared to control by delaying the spoilage mechanisms when stored at -2°C [9]. A combination of citrus and pomegranate peel extract and chitosan nanoparticles for shelf life extension of silver carp fillets has been applied. Pomegranate peel extract was significantly stronger than orange extract in delaying lipid oxidation [10]. The efficacy of *Aloe vera* concentrate and crown of god fruit (*Phaleria macrocarpa*) powder has assessed on the quality attributes of Indian mackerel during storage at 4°C and they reported that 20% *A. vera* treatments were found to be the best treatments to reduce changes in sensory and microbial quality [11]. Clove (*Syzygium aromaticum*) bud extracts and grape (*Vitis vinifera*) seed extracts have efficiently inhibited lipid and protein oxidation in silver carp fillets during chilled storage [12].

Recently, reported that the positive role of mint and citrus extracts in controlling biochemical and microbiological changes in chill stored Indian mackerel [9]. Dark fleshed species like mackerel, tuna, bonito are highly susceptible to oxidation and discoloration during frozen storage. The positive effects of green tea, grape seed, and pomegranate peel extract dip treatment (1% w/v) on the sensory and physical properties of frozen bonito fillets has investigated and reported a marked reduction in muscle structure deformation during frozen storage [13]. The positive influence of rosemary, thyme, black cumin extract and their combinations (0.3%) in controlling moisture loss has demonstrated during the storage of frozen tilapia fillet. [4] Drying and smoking are the oldest methods of fish preservation. The most common method of smoking is cold smoking by using temperatures of 25-30°C which is not

enough to kill the microorganisms. High proportion of smoked or dried fish is destroyed by the attack of maggots and dermestids. Melanosis, the blackening in crustaceans is induced by a biochemical process. Inhibition of melanosis in shrimp has also been achieved by using grape seed extract, green tea extract, and pomegranate peel extract. Shrimp (*Parapenaeus longirostris*) treated with 1.5% grape seed extract had the lowest melanosis as compared to other treatments when stored at 4°C [15]. However, most plant derived extracts are generally regarded as safe by USFDA (21 Code of Federal Regulations CFR 182, 184). Hence, plant extracts extend the scope for multifunctional natural food ingredients serving many useful functions to fish processing sector.

We have found Paprika, Neem leaf powder, Turmeric powder, Salt, etc. has very effective organic preservatives for controlling fungus, insect and rat infestation in our study. Though if dry fishes were prepared in a good condition using organic preservatives then it can be stored for a long time as the ultimate good source of protein and the price of dry fish will be double than raw fish and profit will be fourfold. Recently, Fisheries Scientist invented two new technology named "Fish Drier and Organic method" for reducing uses of different harmful chemicals and pesticides. By using these technology, dry fish can preserve long time with standard quality. Another research also suggested that Chitosan is very effective organic preservative for dry fishes and fruits.

Conclusions

Dry fishes are very common items all over Bangladesh. Comparatively its price is lower than raw fish. If it is possible to dry on roof by consumers will be hygienic for taking as the source of protein. Dry fishes preserve more protein than raw fishes. After preparing dried fishes by the organic preservatives like as Neem leaf powder and Paprika can be used for controlling the infestation of insects and fungus. These organic preservatives are not harmful for human health. Some of the dried fish traders who are the concern about food hygiene, they were normally used organic preservatives for a short period. Nevertheless, if we consider stop adding noxious element into raw fish during dry fish processing then dry fish can be a perfect foodstuff in our daily menu and there is no alternative of cold storage for storing dried fishes for a long time.

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